

DURING the meeting of the Social Science Congress at Brighton, Mr. Booth threw open for three days his private museum which is in the course of arrangement. He has built on the Dyke Road a spacious hall of brick, lighted entirely from above, and around this are being placed 306 cases which contain groups of birds shot by himself and Mrs. Booth in Britain. There is one point about the fixing of the cases worth mentioning. A framework is constructed about three feet from the wall into which the glazed cases fit. This prevents any damp from the walls, too frequent in museums, and allows of the easy moving of the cases if needed. As these cases are arranged in three tiers only and there is abundance of light, every bird can be well seen, and the width of the hall is sufficient to admit of viewing the groups from different positions. The most important feature next perhaps to the careful stuffing of the birds, is the fidelity with which the characters of the habitat are reproduced. With birds which change their plumage during the year, two, and where needed, three illustrations are given each with the proper *entourage*. As a collection illustrating our British birds in their native haunts, this is probably unique. There is no attempt at zoological classification, however, since the position of the cases is influenced rather by their relative size and the general picturesque effect of the hall. Whoever the taxidermist is, the collection does him great credit. It is stated that when complete the collection will be thrown open to the public for the benefit of the local charities.

THE observations obtained by Prof. Violle (referred to last week, p. 527) in reference to the solar temperature, were obtained not by ballooning, but by the actual ascent of the Alps.

UNDER date Oct. 19, the *Times* Paris correspondent states that an earthquake which lasted several seconds is reported as having been felt at Moutiers-et-Brides-les-Bains, near Chambéry. This phenomenon coincided with great barometrical depression. Snow has fallen on the mountains of the Puy de Dôme.

DR. PIETRE SANCTA has just started a new French periodical, the *Journal d'Hygiène*, with the object of realising, as far as possible, in France the ideal of a "city of health." The journal also treats of climatology, mineral waters, wintering and seaside resorts, and kindred subjects.

THE pair of Sea-lions which arrived at Brighton last week are, we are informed, specimens of Steller's Sea-lion, about six feet long. The species, which was originally described by G. W. Steller in a work which also contains the account of the huge extinct Manatee-like *Rhytina*, attains a length of sixteen feet, and has long hair surrounding the neck of the adult male, whence its name. Its under-fur is very little in quantity, so that the skin is of no use for "sealskin."

ON Monday the New Ladies' College, known as Newnham Hall, at the back of the Colleges at Cambridge, was formally opened and received into its rooms twenty-seven students. The resident mistress is Miss Clough, the sister of the poet.

A LETTER in Tuesday's *Times* describes a terrible hurricane and rain and thunder-storm which swept over the island of St. Vincent and other West India islands on the 9th September. In twelve hours the almost incredible quantity of nearly nineteen inches of rain fell.

A COURSE of twelve Gilchrist Lectures, on the Principles of Physical Geography, in connection with the School Teachers' Science Association, is being given at the Foresters' Hall, Wilderness Row, on alternate Friday evenings. The first lecture was given on the 8th inst., and the next will take place tomorrow. The lecturers are Dr. W. B. Carpenter, F.R.S., Mr. J. Norman Lockyer, F.R.S., and Prof. Martin Duncan, F.R.S.

THE evening lectures last session in connection with the Yorkshire College of Science were largely attended, and we are

glad to see they are to be continued this session. Professors Rucker, Thorpe, and Green are to lecture on special departments of Physics, Chemistry, and Geology respectively, and Mr. L. C. Miall on "The Principal Forms of Animal Life."

THE following is the programme of the Glasgow Science Lectures Association for the coming Session:—Nov. 11, "Navigation," by Sir Wm. Thomson, F.R.S.; Nov. 24, "Coals and Coal Plants," by Prof. W. C. Williamson, F.R.S.; Dec. 8, "Recent Researches into the Chemical Constitution of the Sun," by J. Norman Lockyer, F.R.S.; Dec. 22, "Kent's Cavern—its testimony to the Antiquity of Man," by Wm. Pengelly, F.R.S.; Jan. 27, "Mountain Architecture," by Prof. Geikie, F.R.S.; Feb. 16, a lecture by Prof. Huxley, F.R.S., subject not yet announced.

FROM the thirteenth quarterly report of the Sub-Wealden Exploration, it appears that another effort is to be made to reach a depth of 2,000 feet. The engineer has reported favourably on the possibility of completing that distance by attaching a crown to the 3-inch tubes, and, after boring to 1,824 feet, to recommence with a 2½-inch crown.

THE additions to the Zoological Society's Gardens during the past week include two Persian Gazelles (*Gazella subgutturosa*) from Persia, presented by Mr. Archibald Gray; a Ruddy Ichneumon (*Herpestes smithii*) from India, presented by Mr. W. R. Best; a Common Kestrel (*Tinnunculus alaudarius*), European, presented by Mr. J. H. Willmore; a Golden-crowned Conure (*Conurus aureus*) from S.E. Brazil, presented by Col. McArthur; two Crested Porcupines (*Hystrix cristata*), two Servals (*Felis serval*) from S. Africa, a Scarlet Ibis (*Ibis rubra*) from Para, a Common Boa (*Boa constrictor*) from S. America, deposited; a Derbian Wallaby (*Halmaturus derbianus*) born in the Gardens.

A CITY OF HEALTH*

II.

THE warming and ventilation of the houses is carried out by a common and simple plan. The cheerfulness of the fire-side is not sacrificed; there is still the open grate in every room, but at the back of the fire-stove there is an air-box or case which, distinct from the chimney, communicates by an opening with the outer air, and by another opening with the room. When the fire in the room heats the iron receptacle, fresh air is brought in from without, and is diffused into the room at the upper part on a plan similar to that devised by Capt. Galton.

As each house is complete within itself in all its arrangements, those disfigurements called back premises are not required. There is a wide space consequently between the back fronts of all houses, which space is, in every instance, turned into a garden square, kept in neat order, ornamented with flowers and trees, and furnished with playgrounds for children, young and old.

The houses being built on arched subways, great convenience exists for conveying sewage from, and for conducting water and gas into, the different domiciles. All pipes are conveyed along the subways, and enter each house from beneath. Thus the mains of the water-pipe and the mains of the gas are within instant control on the first floor of the building, and a leakage from either can be immediately prevented. The officers who supply the commodities of gas and water have admission to the subways, and find it most easy and economical to keep all that is under their charge in perfect repair. The sewers of the houses run along the floors of the subways, and are built in brick. They empty into three cross main sewers. They are trapped for each house, and as the water supply is continuous, they are kept well flushed. In addition to the house flushings there are special openings into the sewers by which, at any time, under the direction of the sanitary officer, an independent flushing can be carried out. The sewers are ventilated into tall shafts from the mains by means of a pneumatic engine.

* An Address by Dr. B. W. Richardson, F.R.S., at the Brighton meeting of the Social Science Association. Revised by the author. Concluded from p. 525.

The water-closets in the houses are situated on the middle and basement floors. The continuous water supply flushes them without danger of charging the drinking water with gases emanating from the closet; a danger so imminent in the present method of cisterns, which supply drinking as well as flushing water.

As we walk the streets of our model city, we notice first an absence of places for the public sale of spirituous liquors. Whether this be a voluntary purgation in goodly imitation of the National Temperance League, the effect of Sir Wilfred Lawson's Permissive Bill and most permissive wit and wisdom, or the work of the Good Templars, we need not stay to inquire. We look at the fact only. To this city, as to the town of St. Johnsbury, in Vermont, which Mr. Hepworth Dixon has so graphically described, we may apply the description Mr. Dixon has written: "No bar, no dram shop, no saloon defiles the place. Nor is there a single gaming hell or house of ill-repute." Through all the workshops into which we pass, in whatever labour the men or women may be occupied—and the place is noted for its manufacturing industry—at whatever degree of heat or cold, strong drink is unknown. Practically, we are in a total abstiners' town, and a man seen intoxicated would be so avoided by the whole community, he would have no peace to remain.

And, as smoking and drinking go largely together, as the two practices were, indeed, original exchanges of social degradations between the civilised man and the savage, the savage getting very much the worst of the bargain, so the practices largely disappear together. Pipe and glass, cigar and sherry-cobbler, like the Siamese twins, who could only live connected, have both died in our model city. Tobacco, by far the most innocent partner of the firm, lived, as it perhaps deserved to do, a little the longest; but it passed away, and the tobaccoist's counter, like the dram counter, has disappeared.

The streets of our city, though sufficiently filled with busy people, are comparatively silent. The subways relieve the heavy traffic, and the factories are all at short distances from the town, except those in which the work that is carried on is silent and free from nuisance. This brings me to speak of some of the public buildings which have relation to our present studies.

It has been found in our towns, generally, that men and women who are engaged in industrial callings, such as tailoring, shoe-making, dress-making, lace-work and the like, work at their own homes amongst their children. That this is a common cause of disease is well understood. I have myself seen the half-made riding-habit that was ultimately to clothe some wealthy damsel rejoicing in her morning ride, act as the coverlet of a poor tailor's child stricken with malignant scarlet-fever. These things must be in the ordinary course of events, under our present bad ordinary system. In the model city we have in our mind's eye, these dangers are met by the simple provision of workmen's offices or workrooms. In convenient parts of the town there are blocks of buildings, designed mainly after the manner of the houses, in which each workman can have a work-room on payment of a moderate sum per week. Here he may work as many hours as he pleases, but he may not transform the room into a home. Each block is under the charge of a superintendent, and also under the observation of the sanitary authorities. The family is thus separated from the work, and the working man is secured the same advantages as the lawyer, the merchant, the banker now possesses: or, to make the parallel more correct, he has the same advantage as the man or woman who works in a factory and goes home to eat and to sleep.

In most towns throughout the kingdom the laundry system is dangerous in the extreme. For anything the healthy householder knows, the clothes he and his children wear have been mixed before, during, and after the process of washing, with the clothes that have come from the bed or the body of some sufferer from a contagious malady. Some of the most fatal outbreaks of disease I have met with have been communicated in this manner. In our model community this danger is entirely avoided by the establishment of public laundries, under municipal direction. No person is obliged to send any article of clothing to be washed at the public laundry; but if he does not send there he must have the washing done at home. Private laundries that do not come under the inspection of the sanitary officer are absolutely forbidden. It is incumbent on all who send clothes to the public laundry from an infected house to state the fact. The clothes thus received are passed for special cleansing into the disinfecting rooms. They are specially washed, dried,

and prepared for future wear. The laundries are placed in convenient positions, a little outside the town; they have extensive drying grounds, and, practically, they are worked so economically, that home-washing days, those invaders of domestic comfort, are abolished.

Passing along the main streets of the city we see in twenty places, equally distant, a separate building surrounded by its own grounds—a model hospital for the sick. To make these institutions the best of their kind, no expense is spared. Several elements contribute to their success. They are small, and are readily removeable. The old idea of warehousing diseases on the largest possible scale, and of making it the boast of an institution that it contains so many hundred beds, is abandoned here. The old idea of building an institution so that it shall stand for centuries, like a Norman castle, but, unlike the castle, still retain its original character as a shelter for the afflicted, is abandoned. The still more absurd idea of building hospitals for the treatment of special organs of the body, as if the different organs could walk out of the body and present themselves for treatment, is also abandoned.

It will repay us a minute of time to look at one of these model hospitals. One is the *fac simile* of the other, and is devoted to the service of every five thousand of the population. Like every building in the place, it is erected on a subway. There is a wide central entrance, to which there is no ascent, and into which a carriage, cab, or ambulance can drive direct. On each side the gateway are the houses of the resident medical officer and of the matron. Passing down the centre, which is lofty and covered in with glass, we arrive at two side-wings running right and left from the centre, and forming cross-corridors. These are the wards: twelve on one hand for male, twelve on the other for female patients. The cross-corridors are twelve feet wide and twenty feet high, and are roofed with glass. The corridor on each side is a framework of walls of glazed brick, arched over head, and divided into six segments. In each segment is a separate, light, elegant removable ward, constructed of glass and iron, twelve feet high, fourteen feet long, and ten feet wide. The cubic capacity of each ward is 1,680 feet. Each patient who is ill enough to require constant attendance has one of these wards entirely to himself, so that the injurious influences on the sick, which are created by mixing up, in one large room, the living and the dying; those who could sleep, were they at rest, with those who cannot sleep because they are racked with pain; those who are too nervous or sensitive to move, or cough, or speak, lest they should disturb others; and those who do whatever pleases them; these bad influences are absent.

The wards are fitted up neatly and elegantly. At one end they open into the corridor, at the other towards a verandah which leads to a garden. In bright weather those sick, who even are confined to bed, can, under the direction of the doctor, be wheeled in their beds out into the gardens without leaving the level floor. The wards are warmed by a current of air made to circulate through them by the action of a steam-engine, with which every hospital is supplied, and which performs such a number of useful purposes, that the wonder is how hospital management could go on without this assistance.

If at any time a ward becomes infectious, it is removed from its position, and replaced by a new ward. It is then taken to pieces, disinfected, and laid by ready to replace another that may require temporary ejection.

The hospital is supplied on each side with ordinary baths, hot-air baths, vapour baths, and saline baths.

A day sitting-room is attached to each wing, and every reasonable method is taken for engaging the minds of the sick in agreeable and harmless pastimes.

Two trained nurses attend to each corridor, and connected with the hospital is a school for nurses, under the direction of the medical superintendent and the matron. From this school nurses are provided for the town; they are not merely efficient for any duty in the vocation in which they are always engaged, either within the hospital or out of it, but from the care with which they attend to their own personal cleanliness, and the plan they pursue of changing every garment on leaving an infectious case, they fail to be the bearers of any communicable disease. To an hospital four medical officers are appointed, each of whom, therefore, has six resident patients under his care. The officers are called simply medical officers; the distinction, now altogether obsolete, between physicians and surgeons being discarded.

The hospital is brought, by an electrical wire, into communication with all the fire-stations, factories, mills, theatres, and other

important public places. It has an ambulance always ready to be sent out to bring any injured persons to the institution. The ambulance drives straight into the hospital, where a bed of the same height on silent wheels, so that it can be moved without vibration into a ward, receives the patient.

The kitchens, laundries, and laboratories are in a separate block at the back of the institution, but are connected with it by the central corridor. The kitchen and laundries are at the top of this building, the laboratories below. The disinfecting-room is close to the engine-room, and superheated steam, which the engine supplies, is used for disinfection.

The out-patient department, which is apart from the body of the hospital, resembles that of the Queen's Hospital, Birmingham: the first out-patient department, as far as I am aware, that ever deserved to be seen by a generous public. The patients waiting for advice are seated in a large hall, warmed at all seasons to a proper heat, lighted from the top through a glass roof, and perfectly ventilated. The infectious cases are separated carefully from the rest. The consulting rooms of the medical staff are comfortably fitted, the dispensary is thoroughly officered, and the order that prevails is so effective that a sick person, who is punctual to time, has never to wait.

The medical officers attached to the hospital in our model city are allowed to hold but one appointment at the same time, and that for a limited period. Thus every medical man in the city obtains the equal advantage of hospital practice, and the value of the best medical and surgical skill is fairly equalised through the whole community.

In addition to the hospital building is a separate block, furnished with wards, constructed in the same way as the general wards, for the reception of children suffering from any of the infectious diseases. These wards are so planned that the people, generally, send sick members of their own family into them for treatment, and pay for the privilege.

Supplementary to the hospital are certain other institutions of a kindred character. To check the terrible course of infantile mortality of other large cities—the 76 in the 1,000 of mortality under five years of age, homes for little children are abundant. In these the destitute young are carefully tended by intelligent nurses; and mothers, while following their daily callings, are enabled to leave their children under efficient care.

In a city from which that grand source of wild mirth, hopeless sorrow and confirmed madness, alcohol, has been expelled, it could hardly be expected that much insanity would be found. The few who are insane are placed in houses licensed as asylums, but not different in appearance to other houses in the city. Here they live, in small communities, under proper medical supervision, with their own gardens and pastimes.

The houses of the helpless and aged are, like the asylums, the same as the houses of the rest of the town. No large building for the poor of pretentious style uprears itself; no men badged and badgered as paupers walk the place. Those poor who are really, from physical causes, unable to work, are maintained in a manner showing that they possess yet the dignity of human kind; that, being worth preservation, they are therefore worthy of respectful tenderness. The rest, those who can work, are employed in useful labours which pay for their board. If they cannot find work, and are deserving, they may lodge in the house and earn their subsistence; or they may live from the house and receive pay for work done. If they will not work, they, as vagrants, find a home in prison, where they are compelled to share the common lot of mankind.

Our model city is of course well furnished with baths, swimming baths, Turkish baths, playgrounds, gymnasia, libraries, board schools, fine art schools, lecture halls, and places of instructive amusement. In every board school drill forms part of the programme. I need not dwell on these subjects, but must pass to the sanitary officers and offices.

There is in the city one principal sanitary officer, a duly qualified medical man elected by the Municipal Council, whose sole duty it is to watch over the sanitary welfare of the place. Under him as sanitary officers are all the medical men who form the poor-law medical staff. To him these make their reports on vaccination and every matter of health pertaining to their respective districts; to him every registrar of births and deaths forwards copies of his registration returns; and to his office are sent, by the medical men generally, registered returns of the cases of sickness prevailing in the district. His inspectors likewise make careful returns of all the known prevailing diseases of the lower animals and of plants. To his office are forwarded, for examination and analysis, specimens of

foods and drinks suspected to be adulterated, impure, or otherwise unfitted for use. For the conduction of these researches the sanitary superintendent is allowed a competent chemical staff. Thus, under this central supervision, every death and every disease of the living world in that district, and every assumable cause of disease, comes to light and is subjected, if need be, to inquiry.

At a distance from the town are the sanitary works, the sewage pumping works, the water and gas works, the slaughter-houses and the public laboratories. The sewage, which is brought from the town partly by its own flow and partly by pumping apparatus, is conveyed away to well-drained sewage farms belonging to the city, but at a distance from it, where it is utilised on Mr. Hope's plan.

The water supply, derived from a river which flows to the south-west of the city, is unpolluted by sewage or other refuse, is carefully filtered, is tested twice daily, and if found unsatisfactory is supplied through a reserve tank, in which it can be made to undergo further purification. It is carried through the city everywhere by iron pipes. Lead pipes are forbidden.

In the sanitary establishment are disinfecting rooms, a mortuary, and ambulances for the conveyance of persons suffering from contagious disease. These are at all times open to the use of the public, subject to the few and simple rules of the management.

The gas, like the water, is submitted to regular analysis by the staff of the sanitary officer, and any fault he may detect which indicates a departure from the standard of purity framed by the Municipal Council is immediately remedied, both gas and water being exclusively under the control of the local authority.

The inspectors of the sanitary officer have under them a body of scavengers. These each day, in the early morning, pass through the various districts allotted to them, and remove all refuse in closed vans. Every portion of manure from stables, streets, and yards, is in this way removed daily and transported to the city farms for utilisation.

Two additional conveniences are supplied by the sanitary scientific work of this establishment. From steam-works steam is condensed, and a large supply of distilled water is obtained and preserved in a separate tank. This is conveyed by a small main into the city, and at a moderate cost distilled water can be supplied for those domestic purposes for which hard water is objectionable. The second sanitary convenience is a large ozone generator. By this apparatus ozone can be produced in any required quantity, and is made to play many useful purposes. It is passed through the drinking water in the reserve reservoir whenever the water shows excess of organic impurity, and it is conveyed into the city for diffusion into private houses for purposes of disinfection.

The slaughter-houses of the city are all public, and are separated by a distance of a quarter of a mile from the city. They are easily removable edifices, and are under the supervision of the sanitary staff. The Jewish system of inspecting every carcass that is killed is rigorously carried out, with this improvement, that the inspector is a man of scientific knowledge.

All animals used for food—cattle, fowls, swine, rabbits—are subjected to examination in the slaughter-house, or in the market, if they be brought into the city from other depots. The slaughter-houses are so constructed that the animals killed are relieved from the pain of death. They pass through a narcotic chamber, and are brought to the slaughterer oblivious of their fate. The slaughter-houses drain into the sewers of the city, and their complete purification daily, from all offal and refuse, is rigidly enforced.

The buildings, sheds, and styes for domestic food-producing animals, are removed a short distance from the city, and are also under the supervision of the sanitary officer; the food and water supplied for these animals comes equally with human food under proper inspection.

One other subject only remains to be noticed in connection with the arrangements of our model city, and that is the mode of the disposal of the dead. The questions of cremation and of burial in the earth have been considered, and there are some who advocate cremation. For various reasons the process of burial is still retained: firstly, because the cremation process is open to serious medico-legal objections; secondly, because, by the complete resolution of the body into its elementary and inodorous gases in the cremation furnace, that intervening chemical link between the organic and inorganic worlds, the ammonia, is destroyed, and the economy of nature is thereby dangerously disturbed; thirdly, because the natural tendencies

of the people lead them still to the earth, as the most fitting resting-place into which, when lifeless, they should be drawn.

Thus the cemetery holds its place in our city, but in a form much modified from the ordinary cemetery. The burial-ground is artificially made of a fine carboniferous earth. Vegetation of rapid growth is cultivated over it. The dead are placed in the earth from the bier, either in basket-work or simply in the shroud; and the monumental slab, instead of being set over or at the head or foot of a raised grave, is placed in a spacious covered hall or temple, and records simply the fact that the person commemorated was re-committed to earth in those grounds. In a few months, indeed, no monument would indicate the remains of any dead. In that rapidly-resolving soil the transformation of dust into dust is too perfect to leave a trace of residuum. The natural circle of transmutation is harmlessly completed, and the economy of nature conserved.

RESULTS.

Omitting, necessarily, many minor but yet important details, I close the description of the imaginary health city. I have yet to indicate what are the results that might be fairly predicted in respect to the disease and mortality presented under the conditions specified.

Two kinds of observation guide me in this essay: one derived from statistical and sanitary work, the other from experience, extended now over thirty years, of disease, its phenomena, its origins, its causes, its terminations.

I infer, then, that in our model city certain forms of disease would find no possible home, or, at the worst, a home so transient as not to affect the mortality in any serious degree. The infantile diseases, infantile and remittent fevers, convulsions, diarrhoea, croup, marasmus, dysentery, would, I calculate, be almost unknown. Typhus and typhoid fevers and cholera could not, I believe, exist in the city except temporarily and by pure accident; small-pox would be kept under entire control; puerperal fever and hospital fever would probably cease altogether; rheumatic fever, induced by residence in damp houses, and the heart disease subsequent upon it, would be removed; death from privation and from puerpera and scurvy would certainly cease; delirium tremens, liver disease, alcoholic phthisis, alcoholic degeneration of kidney, and all the varied forms of paralysis, insanity, and other affections due to alcohol, would be completely effaced. The parasitic diseases arising from the introduction into the body, through food, of the larvæ of the entozoa, would cease, and that large class of deaths from pulmonary consumption, induced in less-favoured cities by exposure to impure air and badly-ventilated rooms, would, I believe, be reduced so as to bring down the mortality of this signally fatal malady one-third at least.

Some diseases, pre-eminently those which arise from uncontrollable causes, from sudden fluctuations of temperature, electrical storms, and similar great variations of nature, would remain as active as ever; and pneumonia, bronchitis, congestion of the lungs, and summer cholera would still hold their sway. Cancer, also, and allied constitutional diseases of strong hereditary character would yet, as far as we can see, prevail. I fear, moreover, it must be admitted that two or three of the epidemic diseases, notably scarlet fever, measles, and whooping-cough, would assert themselves, and, though limited in their diffusion by the sanitary provisions for arresting their progress, would claim a considerable number of victims.

With these facts clearly in view, I must be careful not to claim for my model city more than it deserves; but calculating the mortality which would be saved, and comparing the result with the mortality which now prevails in the most favoured of our large English towns, I conclude that an average mortality of eight per thousand would be the maximum in the first generation living under this salutary régime. That in a succeeding generation Mr. Chadwick's estimate of a possible mortality of five per thousand would be realised, I have no reasonable doubt, since the almost unrecognised though potent influence of heredity in disease would immediately lessen in intensity, and the healthier parents would bring forth the healthier offspring.

As my voice ceases to dwell on this theme of a yet unknown city of health, do not, I pray you, wake as from a mere dream. The details of the city exist. They have been worked out by those pioneers of sanitary science, so many of whom surround me to-day, and specially by him whose hopeful thought has suggested my design. I am, therefore, but as a draughtsman, who, knowing somewhat your desires and aspirations, have drawn a plan, which you in your wisdom can modify, improve,

perfect. In this I know we are of one mind, that though the ideal we all of us hold be never reached during our lives, we shall continue to work successfully for its realisation. Utopia itself is but another word for time; and some day the masses, who now heed us not, or smile incredulously at our proceedings, will awake to our conceptions. Then our knowledge, like light rapidly conveyed from one torch to another, will bury us in its brightness.

By swift degrees the love of Nature works
And warms the bosom, till at last, sublim'd
To rapture and enthusiastic heat,
We feel the present Deity, and taste
The joy of God to see a happy world!

THE INTERNAL HEAT OF THE EARTH

PROF. MOHR, of Bonn, has contributed to the *Neues Jahrbuch für Mineralogie*, &c. (1875, Heft 4), a very important paper on the causes of the internal heat of the earth. After indicating some of the objections which may be urged against the Plutonistic theory of the origin of the earth's internal heat, he discusses the data obtained by the thermometric investigation of a boring about 4,000 feet deep, through pure rock salt, at Sperenberg, near Berlin.

The proposition from which he starts is as follows:—If the interior of the earth is still fused, then with every increase in depth, as we approach this furnace, a less space must be necessary to produce the same increase of heat. The heat passes outwards by conduction from a smaller into a constantly enlarging sphere, and supposing the conductivity of the materials to be uniform, the temperature of the outer coats of the sphere must gradually diminish in proportion as their volume increases; or, in other words, the increase of heat per 100 feet must become greater and greater in proportion as we descend.

Now the results of the thermometric investigation of the Sperenberg boring give the following numbers:—

For a depth of	Increase per 100 feet.
700 feet	15° 654' R.
900 "	17° 849 "
1100 "	19° 943 "
1300 "	21° 339 "
1500 "	23° 830 "
1700 "	25° 623 "
1900 "	27° 315 "
2100 "	28° 906 "
3390 "	36° 756 "

The third column is a diminishing arithmetical series of the first order, showing equal differences of 0° 050' or $\frac{1}{20}^{\circ}$ R. for every 100 feet. By applying this principle to the gaps left above 700 feet and between 2,100 and 3,390 feet, Prof. Mohr gets the following table of increase of heat for the whole depth:—

Depth.	Increase per 100 feet in depth.
100 to 200 feet	1° 35' R.
200 " 300 "	1° 30 " "
300 " 400 "	1° 25 " "
400 " 500 "	1° 20 " "
500 " 600 "	1° 15 " "
600 " 700 "	1° 10 " "
700 " 900 "	1° 097 " "
900 " 1100 "	1° 047 " "
1100 " 1300 "	0° 997 " "
1300 " 1500 "	0° 946 " "
1500 " 1700 "	0° 896 " "
1700 " 1900 "	0° 846 " "
1900 " 2100 "	0° 795 " "
2100 " 2300 "	0° 745 " "
2300 " 2500 "	0° 695 " "
2500 " 2700 "	0° 645 " "
2700 " 2900 "	0° 595 " "
2900 " 3100 "	0° 545 " "
3100 " 3300 "	0° 495 " "
3300 " 3390 "	0° 445 " "

and from this series he concludes that at a depth of 5,170 feet the increase will be nil, because, as he says, "the end of the increase will come when the last increase of 0° 445' R. is absorbed by the deduction of 0° 05' R., therefore after $\frac{0.445}{0.05}$ or 8.9

strata of 200 feet, and therefore 1,780 feet deeper than 3,390